

REMARKS

The present application was filed on November 21, 2003 with claims 1 through 25. Claims 1 through 25 are presently pending in the above-identified patent application. Claims 13, 15, and 25 are proposed to be amended and new claim 26 is proposed to be added herein.

In the Office Action, the Examiner rejected claims 1-6, 11, 13-18, 23, and 25 under 35 U.S.C. §102(e) as being anticipated by Wilkerson (United States Patent Application Publication Number 2005/0015555). The Examiner indicated that claims 7-10, 12, 19-22, and 24 would be allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

Claims 13 and 15 have been amended to correct typographical errors.

Independent Claims 1 and 13

Independent claims 1 and 13 were rejected under 35 U.S.C. §102(e) as being anticipated by Wilkerson. Regarding claim 1, the Examiner asserts that Wilkerson teaches “determining new state information (i.e. new number of times the cache line being read/hit) for at least two given cache lines of a plurality of cache lines in a cache (i.e. at least two cache lines have to be examined to find out which cache line is the most frequently used compare to other cache line(s)), the new state information based at least in part on prior state information for the at least two given cache lines (i.e. new number of times the cache line being read/hit is always based on the prior number of hits); and when an access miss occurs in one of the at least two given lines: selecting either LFU or MFU replacement criteria (i.e. selecting the MFU replacement criteria); and replacing one of the at least two given cache lines based on the new state information and the selected replacement criteria.”

In the text cited by the Examiner, Wilkerson teaches that “*in another embodiment, the most-frequently-used (FRQ) cache line may be selected.*” (Paragraph 22; emphasis added.) Wilkerson does not disclose or suggest a single embodiment where both LFU and MFU techniques are utilized and, thus, Wilkerson does *not* disclose or suggest selecting either LFU or MFU replacement criteria, as would be apparent to a person of ordinary skill in the art. Independent claims 1 and 13, as amended, require selecting either LFU or MFU replacement criteria.

Thus, Wilkerson does not disclose or suggest selecting either LFU or MFU replacement criteria, as required by independent claims 1 and 13, as amended.

Independent Claim 25

Independent claim 25 was rejected under 35 U.S.C. §102(e) as being anticipated by Wilkerson. Regarding claim 25, the Examiner asserts that Wilkerson discloses replacement circuitry adapted to replace the given cache line determined as the most frequently used (paragraph 22 and FIGS. 2-3).

Applicants note that Wilkerson teaches to use a MFU technique for *identifying a likely Prefetch line*; Wilkerson does **not** disclose or suggest utilizing a MFU technique *to identify a replacement line*. Independent claim 25 requires “*replacement circuitry adapted to replace the given cache line* determined as the most frequently used.”

In addition, Applicants note that Wilkerson teaches that

the most-frequently-used (FRQ) cache line may be selected. One manner of determining the FRQ cache line may be to associate a counter, of a small number of bits, with each cache line in L1 cache 340. In one embodiment, the number of bits may be 8 or 16. The counter may be incremented each time the cache line is referenced, and may be set to zero when a cache line is replaced. To determine the FRQ cache line of a set, the counters may be examined and the cache line with the highest counter value may be selected as the FRQ cache line. This large number of counters and logic may be burdensome to the designer. In another embodiment, a pseudo-most-frequently-used (PFRQ) cache line may be used as an ISL value. In one embodiment, the PFRQ may be determined using a 3-bit saturating counter and a R-bit tag when the cache is 2R-way. The R-bit tag may point to an initial FRQ candidate cache line in the set. Each cache hit to the set may produce the relative age of the referenced cache line, which may be compared to the relative age of the FRQ candidate cache line. If the relative age of the referenced cache line is less than the current RFQ candidate cache line, the 3-bit saturating counter may be incremented. If the relative age of the referenced cache line is more than the current RFQ candidate cache line, the 3-bit saturating counter may be unchanged. If the relative age of the referenced cache line is equal to the current RFQ candidate cache line, the 3-bit saturating counter may be decremented.
(Paragraph 0022; emphasis added.)

As would be apparent to a person of ordinary skill in the art, the embodiments disclosed by Wilkerson will not maintain a **relative MFU count** to indicate the frequency of use of

a cache line relative to one or more other cache lines in cases where, for example, the usage count exceeds the maximum count or saturation count of the MFU counter. Independent claim 25 has been amended to require wherein said state information *includes at least one relative MFU count*; and MFU circuitry adapted to produce new state information for the at least two given cache lines in response to an access to one of the at least two given cache lines *and to maintain said at least one relative MFU count to indicate a frequency of use of at least one of said given cache lines relative to one or more of said given cache lines.*

Thus, Wilkerson does not disclose or suggest wherein said state information includes at least one relative MFU count; and MFU circuitry adapted to produce new state information for the at least two given cache lines in response to an access to one of the at least two given cache lines and to maintain said at least one relative MFU count to indicate a frequency of use of at least one of said given cache lines relative to one or more of said given cache lines, and does not disclose or suggest replacement circuitry adapted to replace the given cache line determined as the most frequently used, as required by independent claim 25, as amended.

New Claim 26

New claim 26 has been added to more particularly point out and distinctly claim various features of the invention, consistent with the scope of the originally filed specification, in order to give applicant the protection to which he is entitled. No new matter is introduced. Support for this material is set forth at pages 12-17 of the originally filed specification. Claim 26 recites wherein said MFU circuitry is further adapted to adjust said at least one relative MFU count when said at least one relative MFU count exceeds a maximum threshold.

As noted below, claim 26 is dependent on claim 25 and is therefore patentably distinguished over Wilkerson because of its dependency from amended independent claim 25 for the reasons set forth above, as well as other elements these claims add in combination to their base claim.

Thus, Wilkerson does not disclose or suggest wherein said MFU circuitry is further adapted to adjust said at least one relative MFU count when said at least one relative MFU count exceeds a maximum threshold, as required by new claim 26.

Allowance of claims 26 is believed to be warranted.

Dependent Claims 2-12, 14-24 and 26

Dependent claims 2-6, 11, 14-18, and 23 were rejected under 35 U.S.C. §102(e) as being anticipated by Wilkerson.

5 Claims 2-12, 14-24, and new claim 26 are dependent on claims 1, 13, and 25, respectively, and are therefore patentably distinguished over Wilkerson because of their dependency from amended independent claims 1, 13, and 25 for the reasons set forth above, as well as other elements these claims add in combination to their base claim. The Examiner has already indicated that claims 7-10, 12, 19-22, and 24 would be
10 allowable if rewritten in independent form including all of the limitations of the base claims and any intervening claims.

All of the pending claims following entry of the amendments, i.e., claims 1-26, are in condition for allowance and such favorable action is earnestly solicited.

15 If any outstanding issues remain, or if the Examiner has any further suggestions for expediting allowance of this application, the Examiner is invited to contact the undersigned at the telephone number indicated below.

The Examiner's attention to this matter is appreciated.

Respectfully submitted,

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